

HEATHKIT[®] MANUAL

for the
**REMOTE CONTROL
ACCESSORY**
Model ET-18-3

Assembly

595-3136



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information (616) 982-3411
Credit (616) 982-3561
Replacement Parts (616) 982-3571

Technical Assistance Phone Numbers

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YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

REMOTE CONTROL ACCESSORY

Model ET-18-3

Assembly

595-3136

WARNING: This instrument is not designed for outdoor use. To prevent fire or shock hazard, do not expose this instrument to rain or moisture.

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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FCC WARNING

Federal Communications Commission requirements prescribe maximum RF radiation from Remote Control devices operating above 25 MHz. This device will meet these requirements when constructed in strict accordance with the instructions in this Manual, using only components and materials supplied with the kit or the exact equivalent thereof. You will be instructed to sign and date the enclosed FCC ID label and affix the label to the equipment certifying that you have constructed this equipment in accordance with the above mentioned instructions. In order to meet legal requirements, be certain to follow the instructions exactly as they are stated in this manual.

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INTRODUCTION

The ET-18-3 Remote Control Accessory allows you to control all of the ET-18 Robot's teaching pendant and keyboard functions from a remote location. The receiver section of the Accessory, which uses an AM superhetrodyne circuit and a microprocessor decoder, features a low power mode when not in use to conserve battery power. The transmitter function is bypassed whenever the teaching pendant is plugged into the Robot. This Accessory mounts easily inside the Robot with only a small wire antenna exposed.

The attractively styled remote unit has a self-contained rechargeable battery which provides operating

power for up to five hours or more. You can recharge the battery overnight using the AC plug-in battery charger that is supplied with the unit.

The transmitter has all of the teaching pendant and hex keyboard controls, and also includes an RS-232C port for loading programs into the Robot from a computer. The preassembled transmitter module transmits on the 75 MHz band and has a range of approximately 100 feet via a telescoping swivel-base antenna. The digitally encoded RF signal is microprocessor controlled. The Remote Control Accessory is supplied with one of three available RF transmitter modules.

UNPACKING

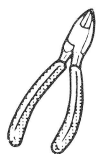
Your kit is packed in one carton, which contains Packs 1 to 4 and a final pack. A number of loose parts, some of which are wrapped, will be considered the "Final Pack." A "Pack Index Sheet" is provided to show you the location of each Pack. You will be instructed to open each pack as it is needed. Do not remove any packs or individual parts from the carton until they are specifically called for in a Parts List.

This Manual has a Parts List for each pack, with its own unpacking instructions which you should read carefully. The sections marked 1-4 on the "Pack Index Sheet" contain the parts for the circuit board assemblies. **It is very important to refer to the "Pack Index Sheet" when the Manual instructs you to locate a certain pack.**

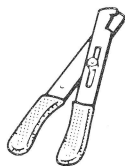
ASSEMBLY NOTES

TOOLS

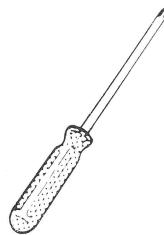
You will need these tools to assemble your kit.



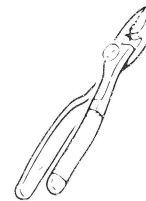
DIAGONAL
CUTTERS



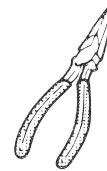
WIRE
STRIPPERS



PHILLIPS
SCREWDRIVER



PLIERS

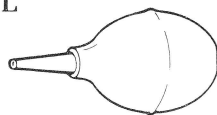


LONG-NOSE
PLIERS

OTHER HELPFUL TOOLS



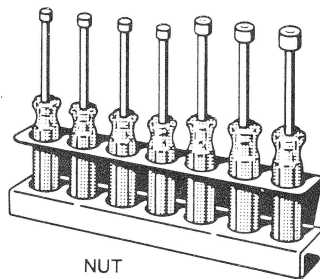
NUT STARTER
(May Be Supplied
With Kit)



DESOLDERING
BULB*

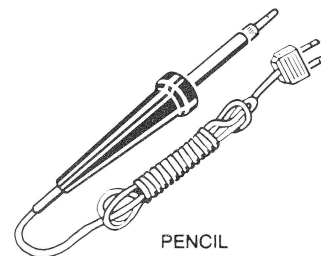


DESOLDERING
BRAID*
(May Be Supplied
With Kit)



NUT
DRIVERS

*To Remove Solder From Circuit Connections.



PENCIL
SOLDERING IRON
(22 to 25 WATTS)

ASSEMBLY

- Follow the instructions carefully. Read the entire step before you perform each operation.
- The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
- Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
- Position all parts as shown in the Pictorials.
- Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List,
- At the beginning of each step where a component is installed,
- In some illustrations,
- In Troubleshooting Charts,
- In the Schematic,
- In the sections at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

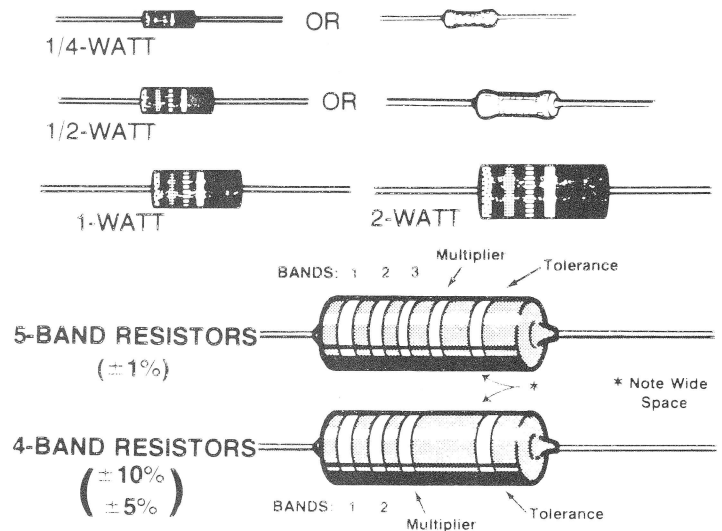
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

PARTS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms). They are usually identified by a color code and four or five color bands, where each color represents a number. These colors (except for the last band, which indicates a resistor's "tolerance") will be given in the steps in their proper order. Therefore, the following color code is given for information only. NOTE: Occasionally, a "precision" or "power" resistor may have the value stamped on it.



Band 1 1st Digit		Band 2 2nd Digit		Band 3 (if used) 3rd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	0	Black	1	Silver	$\pm 10\%$
Brown	1	Brown	1	Brown	1	Brown	10	Gold	$\pm 5\%$
Red	2	Red	2	Red	2	Red	100	Red	$\pm 2\%$
Orange	3	Orange	3	Orange	3	Orange	1,000	Brown	$\pm 1\%$
Yellow	4	Yellow	4	Yellow	4	Yellow	10,000	Green	$\pm .5\%$
Green	5	Green	5	Green	5	Green	100,000	Blue	$\pm .25\%$
Blue	6	Blue	6	Blue	6	Blue	1,000,000	Violet	$\pm .1\%$
Violet	7	Violet	7	Violet	7	Silver	0.01	Gray	$\pm .05\%$
Gray	8	Gray	8	Gray	8	Gold	0.1		
White	9	White	9	White	9				

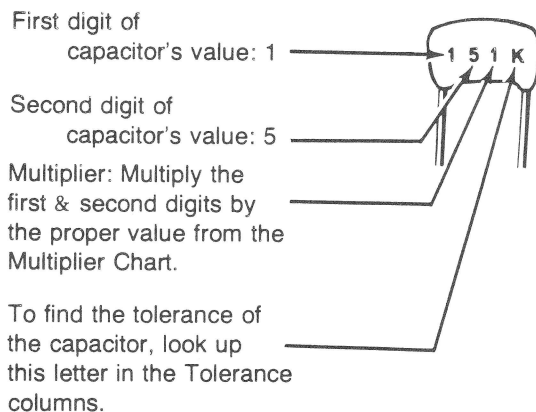
Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:

EXAMPLES:

$$151K = 15 \times 10 = 150 \text{ pF}$$

$$759 = 75 \times 0.1 = 7.5 \text{ pF}$$

NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μF).



MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	$\pm 0.1 \text{ pF}$	B	
1	10	$\pm 0.25 \text{ pF}$	C	
2	100	$\pm 0.5 \text{ pF}$	D	
3	1000	$\pm 1.0 \text{ pF}$	F	$\pm 1\%$
4	10,000	$\pm 2.0 \text{ pF}$	G	$\pm 2\%$
5	100,000		H	$\pm 3\%$
			J	$\pm 5\%$
8	0.01		K	$\pm 10\%$
9	0.1		M	$\pm 20\%$

INTERFACE AND KEYBOARD CIRCUIT BOARDS

PARTS LIST

Remove the parts from Pack 1 and check each part against the following list. The key numbers correspond to the numbers on the "Interface and Keyboard Parts Pictorial" (Illustration Booklet, Page 1). Return any part that is in an individual envelope back into the envelope after you have identified it, until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY	HEATH	QTY.	DESCRIPTION
No.	Part No.		

MISCELLANEOUS

	85-2917-1	1	Interface circuit board
	85-2915-1	1	Keyboard circuit board
A1	432-1265	1	3-pin plug
A2	432-903	3	10-pin plug
A3	490-185	1	Desoldering braid
			Solder

PARTS FROM FINAL PACK

NOTE: Remove the parts from the Final Pack and check them against the following list.

HEATH	QTY.	DESCRIPTION
Part No.		

Wire and Cables

344-58	18"	Gray wire
134-1426	1	Wire with male pins
134-1387	1	2-wire cable w/female pins
134-1425	1	3-wire cable
134-1422	1	6-wire cable w/RS-232C connector
134-1424	1	7-wire cable
134-1386	1	Short 10-wire cable
134-1385	1	Long 10-wire cable
134-1435	1	13-wire cable
134-1384	1	25-wire flat cable
	1	Taped Components Chart
	1	Assembly Manual (See Page 1 for part number)
	1	Operation Manual (See Page 1 for part number)

STEP-BY-STEP ASSEMBLY

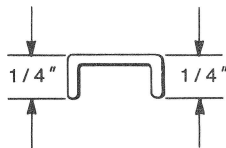
KEYBOARD CIRCUIT BOARD

Refer to Pictorial 1-1 (Illustration Booklet, Page 1) for the following steps.

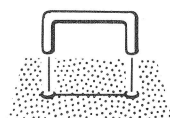
- () Locate the length of gray wire and remove $9\frac{1}{2}$ " of insulation from it to make a $9\frac{1}{2}$ " bare wire.
- () Cut eight 1" and two $\frac{3}{4}$ " lengths of bare wire from the $9\frac{1}{2}$ " bare wire.

NOTE: In the following steps, you will be given detailed instructions on how to install and solder the first wire on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board: resistors, capacitors, diodes, etc.

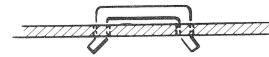
- () Note that one side of the circuit board has the component outlines shown on it. This side of the circuit board is referred to as the "component side." Position the keyboard circuit board as shown in the Pictorial with the component side up. Always install components on the component side of the circuit board, and solder the leads to the foil on the other side.
- () J401: Hold a 1" bare wire as shown and bend $\frac{1}{4}$ " at both ends straight down with your finger to fit the hole spacing on the circuit board.



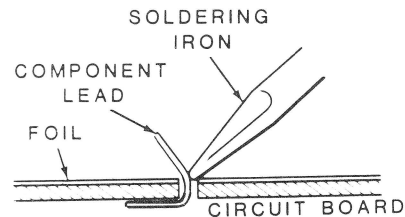
- () Start the ends of the bare wire into the holes at J401. The bare wires are identified on the circuit board by the following circuit board outline:



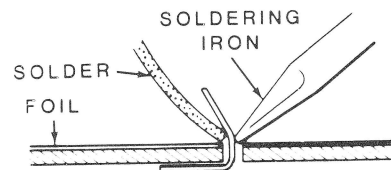
- () Press the bare wire against the circuit board and bend the $\frac{1}{4}$ " ends outward slightly to hold the wire in place.



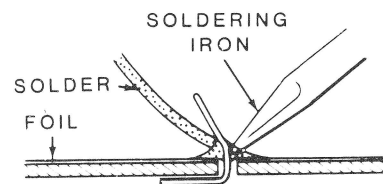
- () Solder the bare wire to the circuit board as follows:



1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.

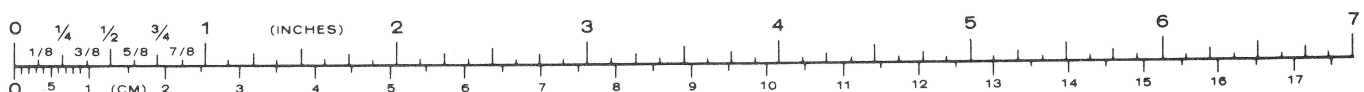


2. Then apply solder to the other side of the connection. **IMPORTANT:** Let the heated lead and the circuit board foil melt the solder.

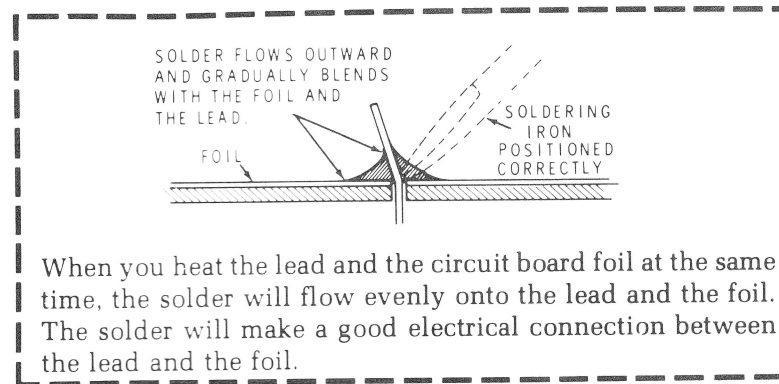


3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.

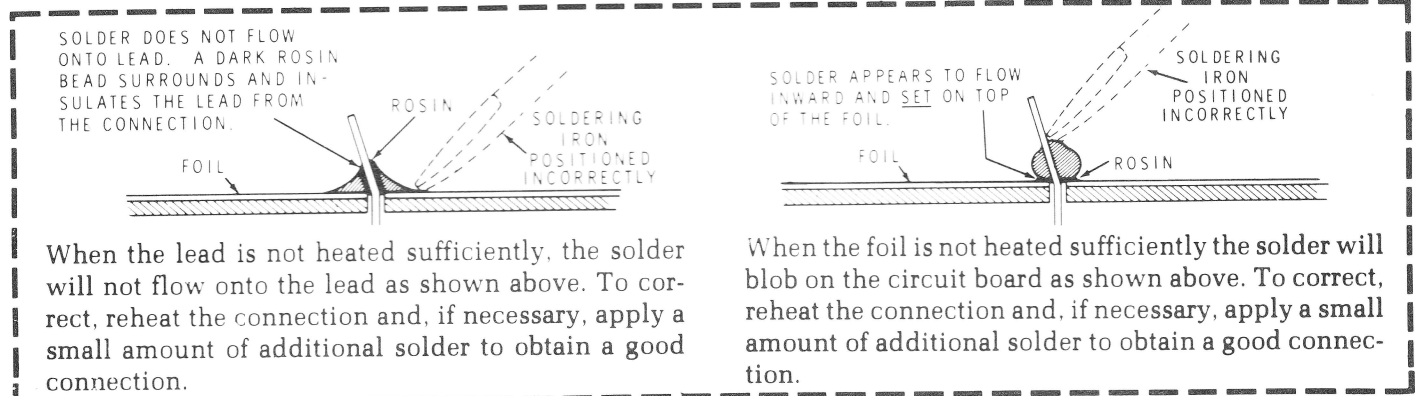
- () Cut off the excess wire lengths close to the connections. Then, compare the solder connections to those in the illustration on Page 11. After you have checked the connections, proceed with the assembly on this Page. Use the same soldering procedure for each connection.



A GOOD SOLDER CONNECTION



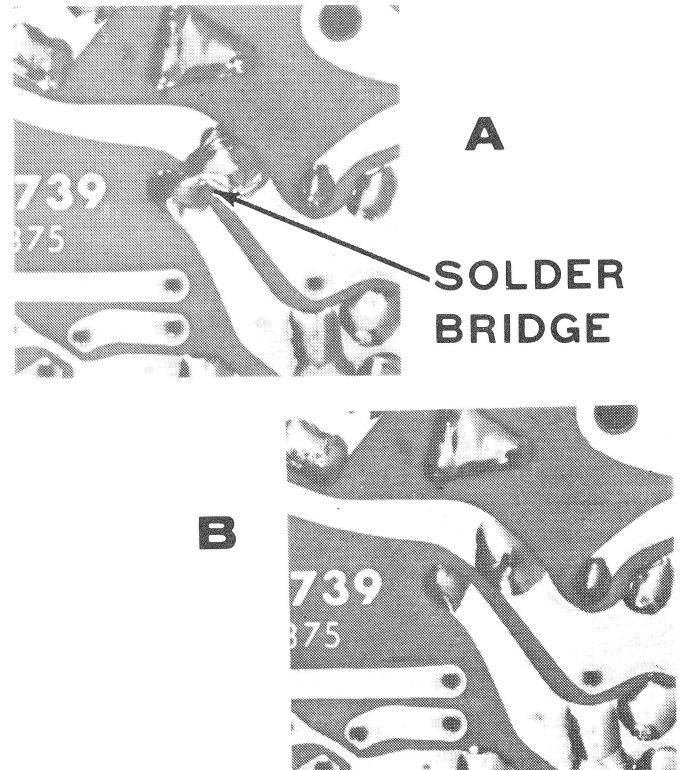
POOR SOLDER CONNECTIONS



SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph A. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



Connect 1" bare wires to the circuit board at the following locations:

- ☐ J402.
- ☐ J403.
- ☐ J404.
- ☐ J406.
- ☐ J407.
- ☐ J408.
- ☐ J409.

Connect 3/4" bare wires to the circuit board at the following locations:

- ☐ J405.
- ☐ J411.

- ☐ Solder the wires to the foil and cut off the excess wire lengths.

Locate the 13-wire cable (#134-1435). Connect the 10 wires coming from the end of the cable to the circuit board as follows. Solder each wire after you connect it and cut off the excess wire length.

- ☐ Violet wire to hole A.
- ☐ Gray wire to hole B.
- ☐ White wire to hole C.
- ☐ Black wire to hole D.
- ☐ Brown wire to hole E.
- ☐ Red wire to hole F.
- ☐ Orange wire to hole G.
- ☐ Yellow wire to hole H.
- ☐ Green wire to hole J.
- ☐ Blue wire to hole K.

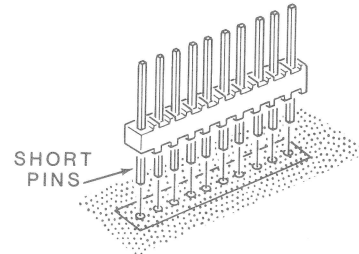
You will connect the remaining white-yellow wire coming from the 15-hole connector later. Set the circuit board aside.

INTERFACE CIRCUIT BOARD

Refer to Pictorial 1-1 for the following steps.

- ☐ Position the interface circuit board with the component side as shown.

NOTE: When you install each of the circuit board plugs in the following steps, insert the shorter pins into the circuit board holes at the location indicated in the step, press the plug body against the circuit board, and solder the pins at each end of the plug to the foil. Check to make sure the plug is flat against the circuit board, then solder the remaining pins to the foil.



- ☐ 10-pin plug at P301.
- ☐ 10-pin plug at P302.
- ☐ 10-pin plug at P303.
- ☐ 3-pin plug at P304.
- ☐ Cut off pin 9 from plug P301.
- ☐ Cut off pin 1 from plug P302.
- ☐ Cut off pin 1 from plug P303.
- ☐ Cut off pin 1 from plug P304.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit boards for the following problems:

- ☐ Unsoldered connections.
- ☐ Poor solder connections.
- ☐ Solder bridges between foil patterns.
- ☐ Protruding leads which could touch together. Trim all leads as close to the foil as possible.

This completes the interface and keyboard circuit board assembly. Set the boards, cables, and remaining gray wire aside until they are called for later.

RECEIVER CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack 2 and from the carton marked "TRANS MOD" and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is in an individual envelope back into the envelope after you have identified it, until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

Refer directly to the enclosed "Taped Components Chart." Follow the instructions at the top of that chart to check the components under "Receiver Circuit Board." The taped parts are in assembly sequence; it is not necessary to check them against the Parts List (at the top of Page 14).

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS

All resistors are 1/4-watt, 5% (last color band gold). The last color band will not be called out.

6-101-12	2	100 Ω (brn-blk-brn)	R205, R227
6-151-12	2	150 Ω (brn-grn-brn)	R209, R232
6-821-12	1	820 Ω (gry-red-brn)	R207
6-102-12	3	1000 Ω (brn-blk-red)	R201, R213, R221
6-222-12	3	2200 Ω (red-red-red)	R215, R216, R217
6-272-12	4	2700 Ω (red-viol-red)	R204, R211, R212, R214
6-562-12	1	5600 Ω (grn-blu-red)	R206
6-682-12	2	6800 Ω (blu-gry-red)	R208, R228
6-103-12	2	10 k Ω (brn-blk-org)	R219, R223
6-153-12	1	15 k Ω (brn-grn-org)	R218
6-183-12	3	18 k Ω (brn-gry-org)	R202, R203, R222

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS (Cont'd.)

6-223-12	1	22 k Ω (red-red-org)	R225
6-273-12	1	27 k Ω (red-viol-org)	R224
6-333-12	2	33 k Ω (org-org-org)	R229, R233
6-683-12	1	68 k Ω (blu-gry-org)	R226
6-184-12	1	180 k Ω (brn-gry-yel)	R231

MISCELLANEOUS

21-784	1	.001 μ F (102) glass ceramic capacitor	C221
45-635	2	1 mH choke (brn-blk-red)	L202, L203
56-84	3	1N4148 diode	D201, D202, D203
475-32	1	RF core	

NONTAPED COMPONENTS

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Receiver Circuit Board Parts Pictorial" (Illustration Booklet, Page 2).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS**Mica**

A1	20-159	1	39 pF	C208
A1	20-110	1	75 pF	C207
A1	20-105	1	180 pF	C213

Ceramic

A2	21-743	2	27 pF	C201, C202
A2	21-27	1	.005 μ F	C219

Electrolytic

A3	25-924	2	2.2 μ F	C212, C218
A3	25-918	1	100 μ F	C217

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

Mylar®

A4	27-129	9	.047 μ F	C203, C204, C205, C206, C209, C211, C214, C215, C216
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INDUCTORS - CHOKE

B1	40-917	1	.217 μ H inductor	T201
B1	40-918	1	.232 μ H inductor	T202
B2	40-319	1	2.2 μ H inductor	L201

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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

LED – TRANSISTORS

C1	412-640	1	LST5053 LED	D204
----	---------	---	-------------	------

NOTE: Transistors may be marked for identification in any one of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one shown.

C2	417-235	2	2N4121 transistor	Q204, Q207
C2	417-293	1	2N5770 transistor	Q202

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

LED – Transistors (Cont'd.)

C2	417-801	5	MPSA20 transistor	Q203, Q205, Q206, Q208, Q209
C2	417-887	1	MPSH10 transistor	Q201

MISCELLANEOUS

	85-2919-2	1	Receiver circuit board	
D1	404-630	3	455 kHz ceramic filter	Y202, Y203, Y204
D2	432-878	2	Circuit board pin	
D3	432-986	1	3-pin right-angle plug	
D4		1	Transmit module	
D5		1	Receive crystal	

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 2-1 (Illustration Booklet, Page 2) for the following steps.

NOTES:

1. Each of the circuit board drawings, like the one shown in Pictorial 2-1, is divided into sections. These sections show you which area of the circuit board you will be working on for a specific series of steps. Refer to the Pictorial whenever you are instructed to install a part.
2. Each series of steps has you installing parts in a top-to-bottom, left-to-right sequence unless you are specifically instructed otherwise.

The step for any specially mounted part will be followed by a special illustration. Refer to the illustration and its circuit board location in the Pictorial before you install the part.

3. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.
4. In general, solder instructions are given only at the end of a series of similar steps. You may solder more often if you desire.
5. Refer to the "Taped Components Chart" before you begin. You will be installing taped components first. They are in assembly sequence.

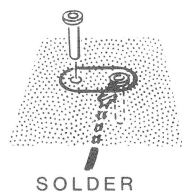
IMPORTANT: The taped components are placed on the strips in assembly sequence to make your kit easier to assemble. However, there are cautions that you should observe during the assembly.

1. Make sure that the circuit component number at the beginning of each step (e.g. R201) matches the component number shown in the Pictorial and on the circuit board.
2. Make sure you match any component part number (e.g. 1N4148 (#56-84)) or color code in a step (e.g. brn-blk-red) with the part number or color code on the "Taped Components Sheet." Remember, if you install a taped component out of sequence in a step, the parts in the steps to follow will most likely be out of step also.

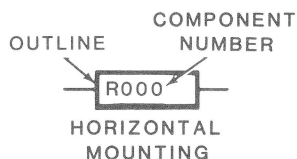
Start at the top of Section 1 of the Pictorial and install the following components on the circuit board.

NOTE: The components in the next step are not on the taped components chart.

- () Insert circuit board pins into the circuit board holes at Y201 and solder the pins to the foil as shown.

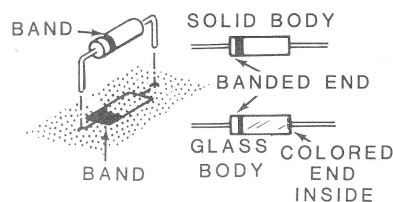


NOTE: The resistors are identified on the circuit board by the following outline:



- () R201: 1000 Ω (brn-blk-red).
 () FB: RF core.
 () R208: 6800 Ω (blu-gry-red).
 () R207: 820 Ω (gry-red-brn).
 () R203: 18 k Ω (brn-gry-org).

NOTE: Whenever you install a diode, as in the following step, always match its banded end with the band mark on the circuit board. A diode will not work properly if it is installed backwards.



CAUTION: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.

- () D201: 1N4148 (#56-84).
 () R202: 18 k Ω (brn-gry-org).
 () R232: 150 Ω (brn-grn-brn).
 () Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 2 of the circuit board as follows:

- () R206: 5600 Ω (grn-blu-red).
 () R204: 2700 Ω (red-viol-red).
 () R205: 100 Ω (brn-blk-brn).
 () R211: 2700 Ω (red-viol-red).
 () R212: 2700 Ω (red-viol-red).
 () R209: 150 Ω (brn-grn-brn).
 () R228: 6800 Ω (blu-gry-red).
 () R233: 33 k Ω (org-org-org).
 () R227: 100 Ω (brn-blk-brn).
 () Solder the leads to the foil and cut off the excess lead lengths.

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Install the components in Section 3 of the circuit board as follows:

- () R213: 1000 Ω (brn-blk-red).
- () L202: 1 mH choke (brn-blk-red). Install the choke with the bands in either direction on the circuit board.
- () R215: 2200 Ω (red-red-red).
- () R214: 2700 Ω (red-viol-red).
- () R231: 180 k Ω (brn-gry-yel).
- () R229: 33 k Ω (org-org-org).
- () C221: .001 μ F (102) glass ceramic.
- () R226: 68 k Ω (blu-gry-org).
- () Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 4 of the circuit board as follows:

- () R217: 2200 Ω (red-red-red).
- () R216: 2200 Ω (red-red-red).
- () L203: 1 mH choke (brn-blk-red).
- () D202: 1N4148 diode (#56-84).
- () R221: 1000 Ω (brn-blk-red).
- () R219: 10 k Ω (brn-blk-org).
- () R218: 15 k Ω (brn-grn-org).
- () R222: 18 k Ω (brn-gry-org).
- () R223: 10 k Ω (brn-blk-org).
- () R224: 27 k Ω (red-viol-org).

- () R225: 22 k Ω (red-red-org).

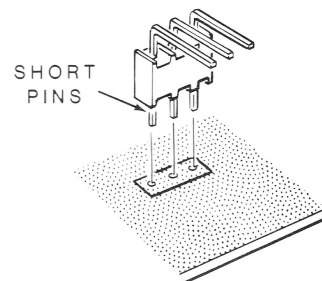
- () D203: 1N4148 diode (#56-84).

- () Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 2-2 (Illustration Booklet, Page 2) for the following steps.

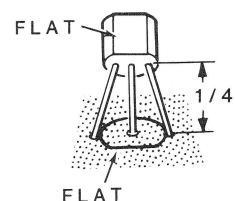
NOTE: You will install the following component out of sequence for easier installation.

- () P201: Refer to the bottom of Section 2 and install the 3-pin right-angle plug at P201. Insert the short pins into the circuit board holes and press the plug against the circuit board. Solder the pins to the foil, making sure the right-angle pins remain horizontal to the circuit board.



Install the components in Section 1 of the circuit board as follows:

NOTE: When you install a transistor, as in the following step, position it so the case flat is over the flat outline of the circuit board. Then insert the E, B, and C leads into their holes and position the bottom of the case $\frac{1}{4}$ " above the circuit board.



() Q202: 2N5770 transistor (#417-293).

NOTE: Ceramic capacitors are identified on the circuit board by the following outline:



() C202: 27 pF ceramic.

NOTE: Mica capacitors are identified on the circuit board by the following outline:



() C208: 39 pF mica.

NOTE: The inductor is identified on the circuit board by the following outline:



() L201: 2.2 μ H inductor (#40-319).

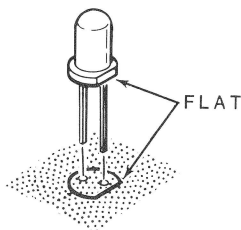
() Q201: MPSH10 transistor (#417-887).

() C207: 75 pF mica.

() C201: 27 pF ceramic.

() Q209: MPSA20 transistor (#417-801).

NOTE: When you install the following LED, position it so the case flat is over the flat outline of the circuit board. Insert the LED leads into the holes until the bottom of the case is against the circuit board. Solder the leads to the foil and cut off the excess lead lengths.



() D204: LED LST5053.

() Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 2 of the circuit board as follows:

NOTE: Ceramic filters are identified on the circuit board by the following outline. They may be installed either way. Solder each filter to the circuit board after you install it.



Install 455 kHz ceramic filters on the circuit board at the following locations:

() Y204.

() Y203.

() Y202.

() Q207: 2N4121 transistor (#417-235).

() Q208: MPSA20 transistor (#417-801).

() Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 3 of the circuit board as follows:

() Q203: MPSA20 transistor (#417-801).

() Q204: 2N4121 transistor (#417-235).

() C213: 180 pF mica.

() Q205: MPSA20 transistor (#417-801).

() C219: .005 μ F ceramic.

() Q206: MPSA20 transistor (#417-801).

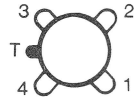
() Solder the leads to the foil and cut off the excess lead lengths.

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Refer to Pictorial 2-3 (Illustration Booklet, Page 3) for the following steps.

Install components in Section 1 of the circuit board as follows:

NOTE: The following inductor is identified on the circuit board by the following outline. Insert the pins into the circuit board holes and solder them to the foil.



() T202: .232 μ H inductor (#40-918).

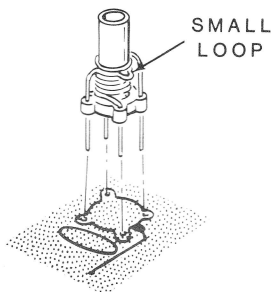
NOTE: Mylar capacitors are identified on the circuit board by the following outline:



() C203: .047 μ F Mylar.

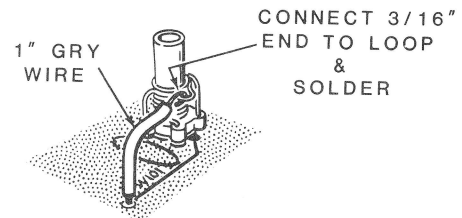
() C204: .047 μ F Mylar.

() T201: .217 μ H inductor (#40-917).



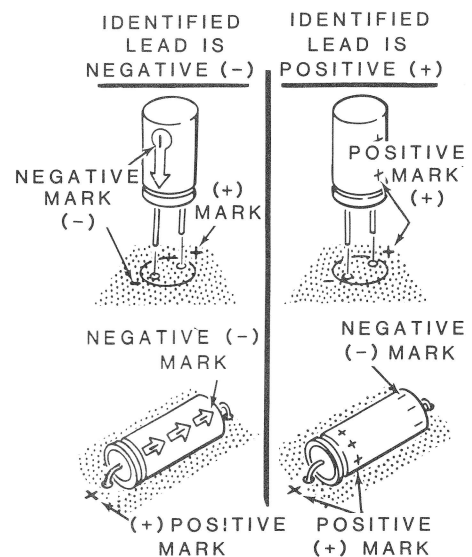
() Locate the gray wire you set aside from the first pack and cut a 1" gray wire. Remove $\frac{3}{16}$ " of insulation from one end of the wire and $\frac{1}{4}$ " from the other end.

() Refer to the following illustration and connect the $\frac{3}{16}$ " end of the 1" gray wire to the protruding winding on inductor T201. Then carefully solder the wire to the coil. Be very careful not to apply more heat than necessary to solder the wire, or you could damage the inductor. Connect the other end of the gray wire to circuit board hole W101. Solder this connection and cut off the excess wire length.



() C205: .047 μ F Mylar.

NOTE: When you install a polarized electrolytic capacitor, always look at it and identify the leads. One lead will have a positive (+) mark or a negative (-) mark near it. **Be sure** to install the positive lead in the positive-marked hole and the negative lead in the negative-marked hole. Be careful; only the negative lead may be marked.



- () C212: 2.2 μ F electrolytic.
- () Solder the leads to the foil and cut off the excess lead lengths.

NOTE: You will install the component at Y201 in this section later.

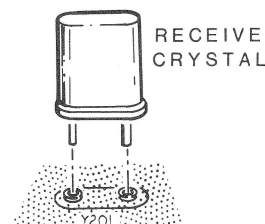
Install components in Section 2 of the circuit board as follows:

- () C209: .047 μ F Mylar.
- () C206: .047 μ F Mylar.
- () C216: .047 μ F Mylar.
- () C217: 100 μ F electrolytic.
- () Solder the leads to the foil and cut off the excess lead lengths.

Install components in Section 3 of the circuit board as follows:

- () C211: .047 μ F Mylar.
- () C215: .047 μ F Mylar.
- () C218: 2.2 μ F electrolytic.
- () C214: .047 μ F Mylar.
- () Solder the leads to the foil and cut off the excess lead lengths.

- () Install the receive crystal pins into the circuit board pins at Y201.



CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

- () Unsoldered connections.
- () Poor solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.
- () Transistors for the proper type and installation.
- () Diodes for the proper positioning of the banded end.
- () Electrolytic capacitors for the correct position of the positive (+) or negative (−) mark.
- () LED for the proper position of the case flat.

This completes the circuit board assembly. Set it aside until it is called for later. Also set the transmit module aside.

TRANSMITTER CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack 3 and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is in an individual envelope back into the envelope after you have identified it, until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

Refer directly to the enclosed "Taped Components Chart." Follow the instructions at the top of that chart to check the components under "Transmitter Circuit Board" The taped parts are in assembly sequence; it is not necessary to check them against the Parts List.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS

NOTE: All resistors are 1/4-watt, 5% (last color band gold).
The last color band will not be called out.

6-271-12	1	270 Ω (red-viol-brn)	R501
6-472-12	2	4700 Ω (yel-viol-red)	R504, R508
6-103-12	5	10 k Ω (brn-blk-org)	R503, R506, R507, R511, R512
6-223-12	1	22 k Ω (red-red-org)	R505
6-473-12	2	47 k Ω (yel-viol-org)	R502, R509

CAPACITOR

21-786	2	.1 μ F (104) glass ceramic	C501, C515
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DIODES

56-56	9	1N4149	D503 – D512
57-65	1	1N4002	D501

NONTAPED COMPONENTS

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Transmitter Circuit Board Parts Pictorial" (Illustration Booklet, Page 3).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

CAPACITORS

A1	21-75	9	100 pF (100K) ceramic	C503–C507, C511, C512, C513, C514
A2	25-838	1	3.3 μ F tantalum	C508
A3	25-917	1	10 μ F electrolytic	C509
A3	25-919	1	150 μ F electrolytic	C502

Transistors – Integrated Circuit (IC) (Cont'd.)

CAUTION: The following integrated circuit can be easily damaged by static electricity. DO NOT remove the IC from its foam pad until you are instructed to do so in a step.

C3	444-250	1	3870 Microprocessor	U502
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CHOKE

B1	45-39	2	4.65 μ H choke	L501, L502
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HARDWARE

D1	250-1414	1	4-40 $\times$ 1/4" phillips screw
D2	252-2	1	4-40 nut
D3	254-9	1	#4 lockwasher

TRANSISTORS – INTEGRATED CIRCUIT (IC)

NOTE: Transistors and integrated circuits may be marked for identification in any one of the following four ways:

1. Part number.
2. Type number. (For integrated circuits, this refers only to the numbers and letters shown in BOLD print in the Parts List. Disregard any other numbers or letters shown on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one shown.

C1	417-235	2	2N4121 transistor	Q501, Q504
C1	417-801	2	MPSA20 transistor	Q502, Q503
C2	442-716	1	LM330 integrated circuit	U501

PLUGS – SOCKETS

E1	432-134	1	Wire socket
E2	432-1039	1	15-pin plug
E3	432-1067	1	15-pin right-angle plug
E4	432-1372	1	6-pin right-angle plug
E5	434-253	1	40-pin socket

MISCELLANEOUS

	85-2916-2	1	Transmitter circuit board	
F1	404-536	1	4 MHz crystal	Y501
F2	473-29	1	Transducer	A501
F3	490-5	1	Nut starter	
F4	490-111	1	IC puller	

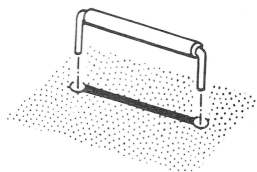
STEP-BY-STEP ASSEMBLY

Refer to Pictorial 3-1 (Illustration Booklet, Page 4) for the following steps.

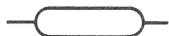
NOTE: Refer to "Transmitter Circuit Board" on the "Taped Components Chart" to install the following taped components. They are in assembly sequence.

Install components in Section 1 of the circuit board as follows:

- () R503: 10 k Ω (brn-blk-org).
- () D503: 1N4149 diode (#56-56). NOTE: Remember to position the banded end of the diode over the banded outline on the circuit board.
- () R506: 10 k Ω (brn-blk-org).
- () R502: 47 k Ω (yel-viol-org).
- () R504: 4700 Ω (yel-viol-red).
- () R505: 22 k Ω (red-red-org).
- () D501: 1N4002 diode (#57-65).
- () J503: Cut a 1" gray wire and remove 1/4" of insulation from each end. Then install the 1" prepared wire at J503 as shown. Repeat this procedure whenever you are instructed to prepare a gray wire.



- () C501: .1 μ F (104) glass ceramic. Glass ceramic capacitors are identified on the circuit board by the following outline:



- () Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 2 of the circuit board as follows. Be sure to keep these components flat against the circuit board.

Install six 1N4149 (#56-56) diodes at the following locations:

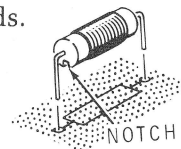
- () D512.
- () D511.
- () D509.
- () D508.
- () D507.
- () D506.
- () R501: 270 Ω (red-viol-brn).
- () D505: 1N4149 diode (#56-56).
- () R508: 4700 Ω (yel-viol-red).
- () Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 3 of the circuit board as follows:

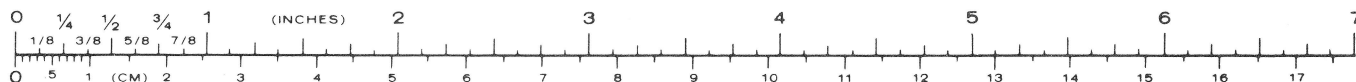
- () Prepare a 3/4" gray wire.
- () Install the 3/4" gray wire at J502.

NOTE: The following **two** components are not located on the taped component strip.

- () L502: 4.65 μ H choke (#45-39). Position the choke body with the notch as shown before you bend the leads.



- () L501: 4.65 μ H choke (#45-39).
- () C515: .1 μ F (104) glass ceramic.
- () R512: 10 k Ω (brn-blk-org).
- () R509: 47 k Ω (yel-viol-org).



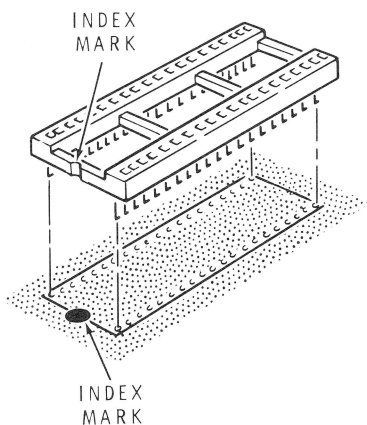
- () R511: 10 k Ω (brn-blk-org).
- () D504: 1N4149 diode (#56-56).
- () R507: 10 k Ω (brn-blk-org).
- () Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 3-2 (Illustration Booklet, Page 4) for the following steps.

You will install the following part out of sequence.

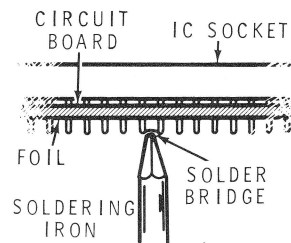
NOTES:

1. To install an IC socket, make sure the pins are straight. Then start the pins into the circuit board with the socket notch over the index mark as shown. Solder the pins at two opposite corners of the socket and check to make sure the socket is flat against the board; then solder the remaining pins to the board.



2. It is very easy to form a solder bridge between foils when you solder IC pins. After you install an IC socket, carefully inspect the foil for solder bridges and remove any that you find as described below. If you suspect that you have a solder bridge but are not positive, you can check your foil pattern against the one shown on Page 8 of the Illustration Booklet that is included with the Operation Manual.

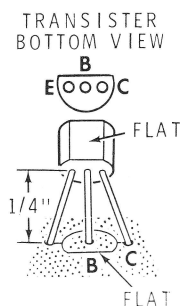
3. To remove a solder bridge, hold the circuit board component-side-up as shown and hold your soldering iron tip between the two points that are bridged. The solder will flow down the soldering iron tip.



- () Install the 40-pin IC socket at U502.

Install components in Section 1 of the circuit board as follows:

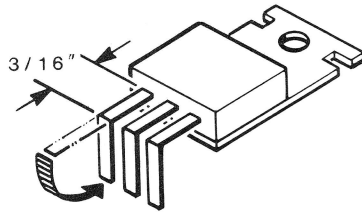
NOTE: When you install each of the following transistors, position it so the flat side of the case is over the outline of the flat on the circuit board. Then insert the E, B, and C leads into their holes and position the bottom of the case 1/4" above the circuit board. Solder the leads to the foil after you install each transistor and cut off the excess lead lengths.



- () Q502: MPSA20 transistor (#417-801).
- () Q501: 2N4121 transistor (#417-235).

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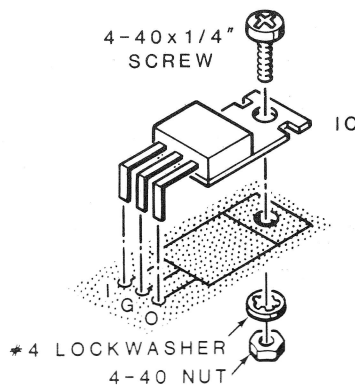
- () Position the LM330T integrated circuit (#442-716) as shown. Then measure the leads $\frac{3}{16}$ " from the end of the case and bend the leads down 90°.



NOTE: Use the nut starter to hold and start 4-40 and 6-32 nuts on screws.

- () U501: Install the prepared LM330T integrated circuit at U501 as follows:

1. Insert the leads into the "I, G, and O" circuit board holes. Then mount the IC to the board with a 4-40 $\times$ $\frac{1}{4}$ " screw, 4-40 nut, and #4 lockwasher.



2. Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 2 of the circuit board as follows:

- () Q503: MPSA20 transistor (#417-801).

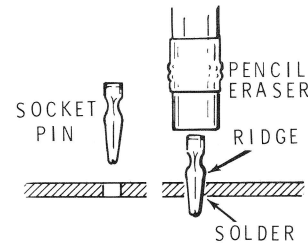
Install 100 pF (100K) ceramic capacitors on the circuit board at the following locations:

- () C512.
() C513.
() C514.

- () C507.

- () Solder the leads to the foil and cut off the excess lead lengths.

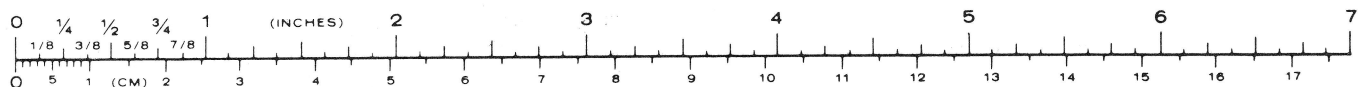
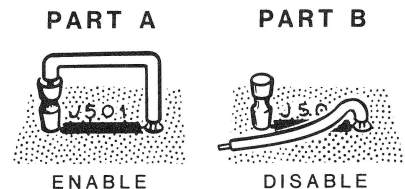
- () Install a wire socket at J501. Insert the connector into the circuit board hole as far as the shoulder; then solder it to the foil. Be careful not to apply too much heat or solder, or the solder will flow up into the socket and fill it.



- () Cut a 1" gray wire and remove $\frac{1}{4}$ " of insulation from each end.

- () Solder one end of the prepared 1" gray wire to circuit board hole J501.

- () The Remote Control Accessory has a special "Automatic Centering" feature for the Robot steering. With this feature enabled and when the Robot is stationary, the steering will automatically recenter itself when the teaching pendant or remote control transmitter's MOTION (steering) switch is released following a turn. With the feature disabled and when the Robot is stationary, you must manually recenter the steering with the MOTION switch. If you wish the automatic feature enabled, install the jumper wire into the wire connector as shown in Part A. If you wish to disable the feature, leave the jumper at J501 disconnected and position it flat against the circuit board as shown in Part B. NOTE: When the Robot is in motion, the steering will always return to center automatically when you release the switch.

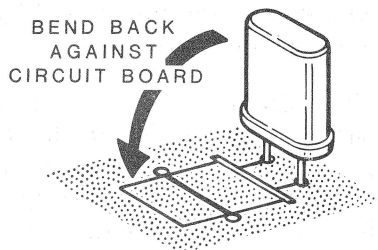


Install the components in Section 3 of the circuit board as follows:

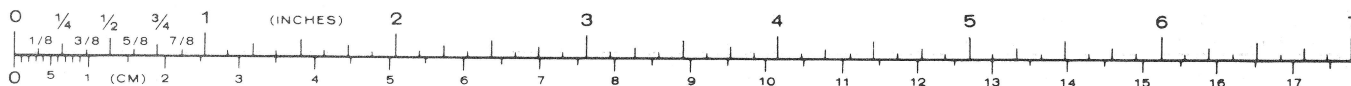
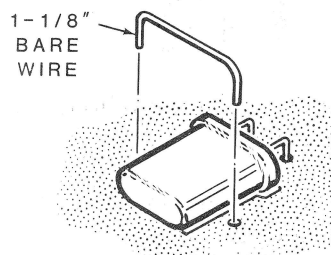
Install four 100 pF (100K) ceramic capacitors on the circuit board at the following locations:

- () C506.
- () C505.
- () C504.
- () C503.
- () Remove 1 1/8" of insulation from the gray wire and then remove the bare wire.
- () Install the 4 MHz crystal on the circuit board at Y501 as follows:

1. Insert the crystal leads into the circuit board holes at Y501 and bend the body back against the circuit board so it is inside the circuit board outline.



2. Form the 1 1/8" bare wire you prepared previously over the crystal body and insert the wire ends into the circuit board holes. Make sure the wire holds the crystal tightly against the board and then solder the bare wire ends and the crystal leads to the foil. Cut off the excess lengths.



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() Q504: 2N4121 transistor (#417-235).

() C511: 100 pF (100K) ceramic.

NOTE: When you install the following tantalum electrolytic capacitor, position the positive marking or color dot on the body next to the positive mark on the circuit board.

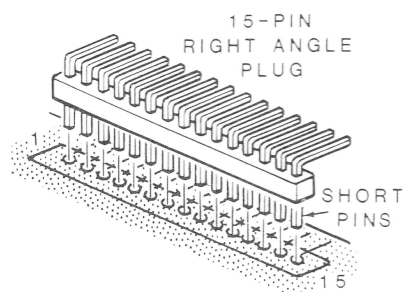
() C508: 3.3 μ F tantalum.

() Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 3-3 (Illustration Booklet, Page 5) for the following steps.

Install the components in Section 1 on the circuit board as follows:

() P501: Install the 15-pin right angle plug at P501. Insert the short plug pins into the circuit board holes and press the plug body flat against the circuit board so the right-angle pins are parallel to the board. Then solder the pins to the foil, making sure the body remains flat against the board.



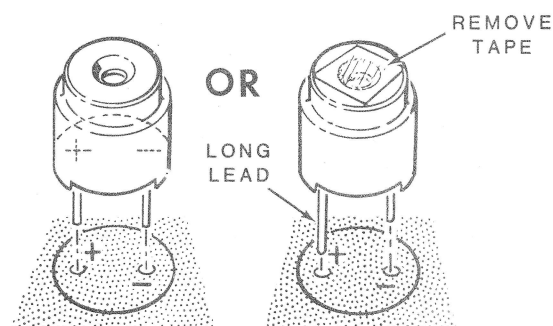
() Cut off pin 13 from P501.

() P502: 15-pin plug.

() Cut off pins 7 and 8 from P502.

() C502: 150 μ F electrolytic.

() A501: Transducer. Note the positive-marked (+) (or long lead) and negative-marked (-) (or short lead) on the transducer. Then insert the (+) (long lead) and (-) (short lead) transducer leads into the (+) and (-) circuit board holes. Press the transducer flat against the board and solder the pins to the foil. Cut off the excess pin lengths.



() If installed, remove the piece of tape from over the transducer hole.

Install the components in Section 2 of the circuit board as follows:

() P503: 6-pin right-angle plug.

() C509: 10 μ F electrolytic.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following problems.

() Unsoldered connections.

() Poor solder connections.

() Solder bridges between foil patterns.

() Protruding leads which could touch together.

- () • Check transistors for the proper type and installation.
- () Check diodes for the proper positioning of the banded end.
- () Check electrolytic and tantalum capacitors for the correct position of the positive (+) or negative (−) mark.

NOTE: The following “protected” IC is a CMOS (complementary metal-oxide semiconductor) device. It is rugged and reliable when installed; however, it can be damaged by static electricity if you are not careful once you remove it from its foam packing. DO NOT lay the IC down or let go of it until it is installed in its socket. When you bend the leads of the IC, hold it in one hand and place your other hand on your work surface before you touch the IC to equalize any static electricity between the work surface and the IC.

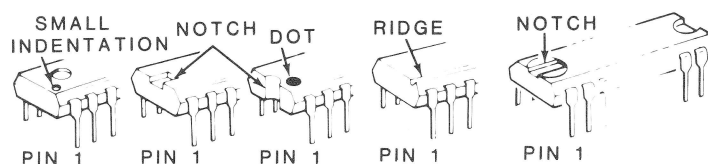
The pins on the IC may be bent out at an angle, so they do not line up with the holes in the IC socket. DO NOT try to install the IC without first bending the pins as described below. To do so may damage the IC pins or the socket, causing intermittent contact.



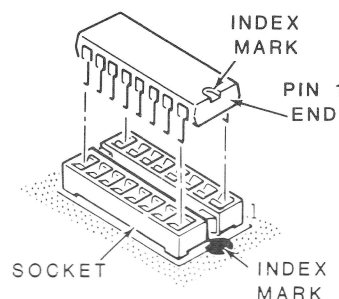
Before you install the IC, lay it down on its side as shown below and very carefully roll it toward the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same manner.



Compare the IC to the drawing shown below. Then determine which end of the IC is the pin 1 end.

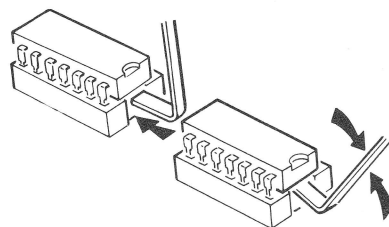


When you install the IC in the next step, position the pin 1 end over the index mark on the circuit board. Then start the IC pins into the socket. Make sure that all 40 pins are started into the socket holes. Then push the IC firmly into the socket. NOTE: An IC pin can become bent under the IC and it will appear as though it is correctly installed in the socket.



- () U502: Install the 3870 microprocessor IC (#444-250) at U502.

NOTE: Should it ever become necessary to remove an IC, insert the IC puller it beneath the IC. Then gently rock it up and down to lift the IC as shown.



This completes the transmitter circuit board assembly. Set it aside until it is called for later.

LOGIC CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack 4 and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is in an individual envelope back into the envelope after you have identified it, until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

Refer directly to the enclosed "Taped Components Chart." Follow the instructions at the top of that chart to check the components under "Logic Circuit Board." The taped parts are in assembly sequence; it is not necessary to check them against the Parts List.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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RESISTORS

NOTE: All resistors are 1/4-watt, 5%.

6-221-12	1	220 Ω (red-red-brn)	R125
6-102-12	1	1000 Ω (brn-blk-red)	R126
6-222-12	10	2200 Ω (red-red-red)	R101, R102, R103, R104, R105, R108, R112, R115, R116, R117 R107, R111, R114, R118, R122
6-103-12	5	10 k Ω (brn-blk-org)	R106, R109, R113, R119, R121, R123, R124 R127
6-273-12	7	27 k Ω (red-viol-org)	
6-473-12	1	47 k Ω (yel-viol-org)	

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS

21-769	5	.01 μ F (103) glass ceramic	C124-C128
21-786	1	.1 μ F glass (104) ceramic	C121

DIODE

56-56	3	1N4149	D101-D103
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NONTAPED COMPONENTS

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Logic Circuit Board Parts Pictorial" (Illustration Booklet, Page 5).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS**Ceramic**

A1	21-75	8	100 pF (100K)	C112-C119, C123
A1	21-56	6	470 pF (470K)	C101-C106
A1	21-140	1	.001 μ F	C107

Electrolytic

A2	25-930	1	2.2 μ F	C108
A3	25-838	1	3.3 μ F tantalum	C109
A4	25-917	2	10 μ F	C111, C122
A4	25-918	1	100 μ F	C123

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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TRANSISTORS – INTEGRATED CIRCUIT (IC)

NOTE: Transistors and integrated circuits may be marked for identification in any one of the following four ways:

1. Part number.
2. Type number. (For integrated circuits, this refers only to the numbers and letters shown in **BOLD** print in the Parts List. Disregard any other numbers or letters shown on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one shown.

B1	417-801	5	MPSA20 transistor	Q101-Q105
B2	417-819	1	MJE171 transistor	Q107
B3	417-881	1	MPSA13 transistor	Q106

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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Transistors – Integrated Circuit (IC) (Cont'd.)

B4	443-780	2	74LS08	U101, U102
B4	443-791	1	74LS244	U108
B4	443-1007	4	74LS26	U103 – U106

CAUTION: The following integrated circuit can be easily damaged by static electricity. DO NOT remove the IC from its foam pad until you are instructed to do so in a step.

B4	444-250	1	Microprocessor	U107
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HARDWARE

C1	250-1469	1	4-40 × 5/16" black phillips screw	
C2	252-2	1	4-40 nut	
C3	254-9	1	#4 lockwasher	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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PLUGS – SOCKETS

D1	432-903	1	10-pin plug	
D2	432-946	2	25-pin plug	
D3	434-298	6	14-pin IC socket	
D3	434-311	1	20-pin IC socket	
D3	434-253	1	40-pin IC socket	

MISCELLANEOUS

	85-2947-1	1	Logic circuit board	
E1	404-536	1	4 MHz crystal	Y101

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 4-1 (Illustration Booklet, Page 6) for the following steps.

Refer to "Logic Circuit Board" in the "Taped Components Chart" before you begin. You will install the taped components first. They are in assembly sequence.

Install components in Section 1 of the circuit board as follows:

- () D103: 1N4149 diode (#56-56).
- () D102: 1N4149 diode (#56-56).
- () R116: 2200 Ω (red-red-red).
- () R117: 2200 Ω (red-red-red).
- () R119: 27 k Ω (red-viol-org).
- () R118: 10 k Ω (brn-blk-org).
- () R126: 1000 Ω (brn-blk-red).
- () R121: 27 k Ω (red-viol-org).
- () R127: 47 k Ω (yel-viol-org).

- () R123: 27 k Ω (red-viol-org).
- () C124: .01 μ F (103) glass ceramic.
- () D101: 1N4149 diode (#56-56).
- () R115: 2200 Ω (red-red-red).
- () R122: 10 k Ω (brn-blk-org).
- () C121: .1 μ F (104) glass ceramic.
- () R124: 27 k Ω (red-viol-org).
- () R125: 220 Ω (red-red-brn).
- () Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 2 of the circuit board as follows:

- () R114: 10 k Ω (brn-blk-org).
- () R112: 2200 Ω (red-red-red).
- () R113: 27 k Ω (red-viol-org).

Install three .01 μ F (103) glass ceramic capacitors on the circuit board as follows:

- () C126.
- () C125.
- () C127.

() R108: 2200 Ω (red-red-red).

() R109: 27 k Ω (red-viol-org).

() R111: 10 k Ω (brn-blk-org).

() R106: 27 k Ω (red-viol-org).

() R107: 10 k Ω (brn-blk-org).

() R104: 2200 Ω (red-red-red).

() R103: 2200 Ω (red-red-red).

() C128: .01 μ F (103) glass ceramic.

() R105: 2200 Ω (red-red-red).

() R102: 2200 Ω (red-red-red).

() R101: 2200 Ω (red-red-red).

() Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 4-2 (Illustration Booklet, Page 6) for the following steps.

Install the components in Section 1 of the circuit board as follows:

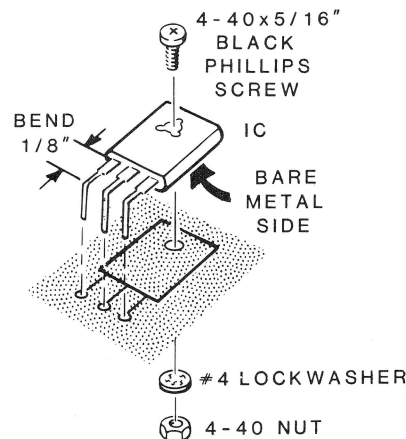
NOTE: Solder each IC socket to the foil after you install it on the circuit board.

() 14-pin IC socket at U101.

() 14-pin IC socket at U102.

() 20-pin IC socket at U108.

() Position the bare metal side of the MJE171 (#417-819) transistor facing down. Then bend the leads down 90° $\frac{1}{8}$ " from the case as shown.



() Q107: Insert the leads of the prepared MJE171 transistor into the E, B, and C circuit board holes at Q107 and secure the transistor to the circuit board with a 4-40 $\times$ $\frac{5}{16}$ " black phillips screw, a #4 lockwasher, and a 4-40 nut.

() Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 2 of the circuit board as follows:

() 14-pin IC socket at U103.

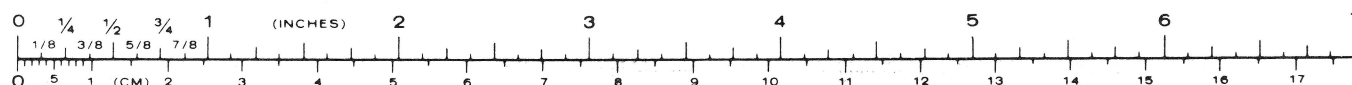
() 14-pin IC socket at U104.

() 14-pin IC socket at U106.

() 40-pin IC socket at U107.

() 14-pin IC socket at U105.

() Remove $1\frac{1}{8}$ " of insulation from the gray wire and remove the $1\frac{1}{8}$ " bare wire.



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- () Y101: Insert the leads of the 4 MHz crystal into the circuit board holes at Y101 and bend the body back against the board. Then form the 1½" bare wire over the crystal and into the circuit board holes. Make sure the crystal body is against the board; then solder the bare wire and the crystal leads to the foil and cut off the excess lengths.

Refer to Pictorial 4-3 (Illustration Booklet, Page 7) for the following steps.

Install the components in Section 1 of the circuit board as follows:

- () C107: .001 μ F ceramic.
- () C108: 2.2 μ F electrolytic. Remember to position the positive- marked (+) end toward the positive (+) mark on the circuit board or the negative-marked (–) end toward the negative (–) mark on the circuit board.

- () Q104: MPSA20 transistor (#417-801).

- () Q105: MPSA20 transistor (#417-801).

- () Q106: MPSA13 transistor (#417-881).

Install eight 100 pF (100K) ceramic capacitors as follows:

- () C112.
- () C119.
- () C118.
- () C117.
- () C116.
- () C115.
- () C114.
- () C113.

- () C109: 3.3 μ F tantalum electrolytic.

- () Solder the leads to the foil and cut off the excess lead lengths.

Install the components in Section 2 of the circuit board as follows:

- () Q103: MPSA20 transistor (#417-801).

- () C106: 470 pF (470K) ceramic.

- () C105: 470 pF (470K) ceramic.

- () Q101: MPSA20 transistor (#417-801).

- () Q102: MPSA20 transistor (#417-801).

Install four 470 pF (470K) ceramic capacitors as follows:

- () C104.
- () C103.
- () C102.
- () C101.

- () Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 4-4 (Illustration Booklet, Page 7) for the following steps.

NOTE: Solder the shorter plug pins to the circuit board foil after you install each plug in the following steps.

- () P102: 25-pin plug. Make sure the plug body remains flat against the circuit board.

- () P101: 25-pin plug.

- () P103: 10-pin plug.

- () Cut off pin 9 on plugs P101 and P103.

- () C123: 100 μ F electrolytic.

- () C122: 10 μ F electrolytic.

- () C111: 10 μ F electrolytic.

Locate the 3-wire (brn-red-org) cable (#134-1425). Connect the individual cable wires to the circuit board as follows. Solder each wire after you install it and cut off the excess wire lengths.

- () Brown wire to hole C.

- () Red wire to hole A.

- () Orange wire to hole B.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following problems.

- ☐ Unsoldered connections.
- ☐ Poor solder connections.
- ☐ Solder bridges between foil patterns.
- ☐ Protruding leads which could touch together.
- ☐ Check transistors for the proper type and installation.
- ☐ Check diodes for the proper positioning of the banded end.
- ☐ Check electrolytic and tantalum capacitors for the correct position of the positive (+) or negative (−) mark.

Refer to Pictorial 4-5 (Illustration Booklet, Page 8) for the following steps.

Install ICs in their circuit board sockets as follows. Refer back to the installation procedure for protected ICs on Page 28, if necessary.

☐ U101: 74LS08 IC (#443-780).

☐ U102: 74LS08 IC (#443-780).

Install four 74LS26 ICs (#443-1007) at the following locations:

☐ U103.

☐ U104.

☐ U106.

☐ U105.

☐ U108: 74LS244 IC (#443-791).

☐ U107: 3870 IC (#444-250).

☐ Double-check the IC installation for the type and location of the pin 1 end.

This completes the circuit board assembly. Set it aside until it is called for later.

CASE

PARTS LIST

Remove the remaining parts from the carton and check each part against the following list. The key numbers correspond to the numbers on the "Case Parts Pictorial" (Illustration Booklet, Page 9). Return any part that is in an individual envelope back into the envelope after you have identified it, until that part is called for in a step. Do not throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY	HEATH	QTY.	DESCRIPTION
No.	Part No.		

PLASTIC PARTS

A1	92-810	1	Case top
A2	92-811	1	Case bottom
A3	260-700	1	Grommet
A4	260-701	1	Retaining ring
A5	354-5	5	Cable tie
A6	462-1177	2	Rectangular knob
A7	490-109	1	Alignment tool

HARDWARE

NOTE: The hardware is shown full size so you can place any nut, screw, etc, you are uncertain about over the drawing. Also, the hardware may be packed in more than one envelope. Open all of the envelopes (marked HDW) before you check the hardware against the Parts List.

#4 Hardware

B1	250-1414	2	4-40 × ¼" phillips screw
B2	250-1415	1	4-40 × ⅝" phillips screw
B3	250-1410	4	4-40 × ¼" phillips flat head screw
B4	250-1194	6	4-40 × ½" T-bolt
B5	252-2	16	4-40 nut

KEY	HEATH	QTY.	DESCRIPTION
No.	Part No.		

Hardware (cont'd.)

B6	254-9	12	#4 lockwasher
B7	255-74	6	Spacer
B8	255-757	2	4-40 threaded hex spacer

#6 Hardware

C1	250-1325	3	6-32 × ¼" black phillips screw
C2	250-1430	1	6-32 × ½" phillips screw
C3	250-1435	6	#6 × ½" black self-tapping phillips screw
C4	254-1	9	#6 lockwasher
C5	255-735	8	6-32 threaded round spacer

SWITCHES

D1	60-78	2	Slide switch	SW1, SW2
D2	61-44	1	Rocker switch	SW3
D3	64-939	1	Keypad	

BRACKETS

E1	204-2733-2	1	Rear mounting bracket
E2	204-2734	1	Interface bracket

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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MISCELLANEOUS

F1	6-331-12	1	330 Ω , 5%, 1/4-watt (org-org-brn-gld) resistor	
F2	73-147	1	Adhesive foam tape	
F3	142-732-80	1	Telescoping antenna	
F4	142-732-81	1	Antenna solder lug	
F5	142-732-82	1	Antenna nut	
F6	142-733	1	Receiving antenna	
F7	206-1491	1	Shield	
F8	261-50	4	Foot	
F9	390-2683	1	Antenna flag	
F10	390-2013-11	1	FCC label*	
F11	390-2586	1	Label sheet, consisting of: Keyboard/pendant label* Motion switch label*	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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MISCELLANEOUS (cont'd.)

F12		1	Blue and white label*	
F13	412-658	1	LST5053 red LED	
F14	418-44	1	Battery	
F15	436-45	1	Charging jack	
F16	490-226	1	Antenna wrench	
F17	150-75	1	6-volt battery charger	

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 5-1 (Illustration Booklet, Page 10) for the following steps.

- () Position the case bottom as shown.

Refer to Detail 5-1A for the following steps.

- () P1: Locate the 6-wire cable w/RS-232C connector and mount the RS-232C connector to the rear mounting bracket at P1 with two 4-40 threaded hex spacers, #4 lockwashers, and 4-40 nuts. Position the pin 1 end of the connector as shown.
- () J1: Mount the charging jack to the rear mounting bracket at J1 with the hardware supplied with the jack. Position the jack with the lugs as shown. Do not overtighten the mounting nut.
- () Cut two 1/2" pieces and two 3/4" pieces of adhesive foam tape from the 3" piece.
- () Refer to Detail 5-1A and remove the paper backing from one side of the 1/2" pieces of adhesive foam tape. Press the tape onto the rear mounting bracket flange as shown.

- () Refer to Detail 5-1B and remove the paper backing from one side of the 3/4" pieces of foam tape. Press the tape onto the inside edge of the case bottom brackets as shown.

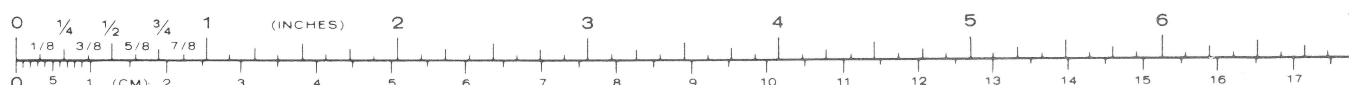
- () Refer to Detail 5-1B, position the battery with the positive (+) and negative (-) terminals as shown, and mount the battery into the two case bottom brackets.

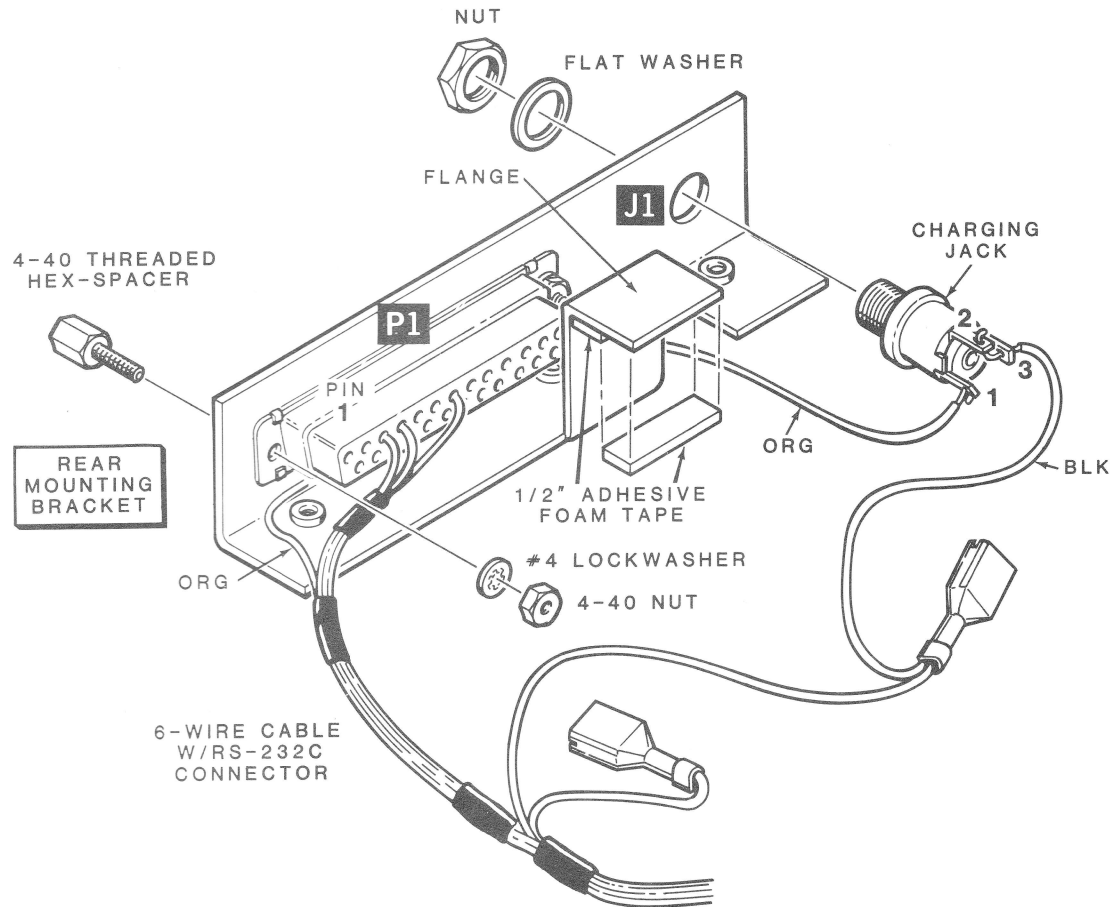
NOTE: In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number following it, such as (S-3), means to solder the connection. The number three tells you that there are three wires and/or leads in the connection.

Connect the wires coming from the 6-wire cable w/RS-232C connector to the charging jack as follows. After you solder each wire, cut off the excess wire length.

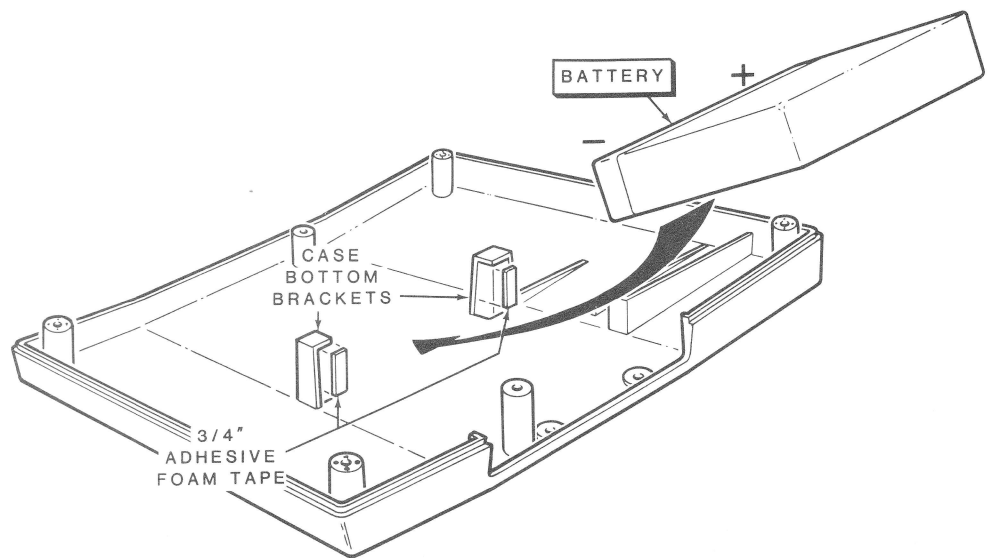
- () Orange wire to lug 1 (S-1).
- () Remove an extra 1/4" of insulation from the black wire.
- () Black wire through lug 3 (S-2) to lug 2 (S-1).
NOTE: The solder step at lug 3 counts as two connections, one entering and one leaving the lug.

*Located inside the Manual





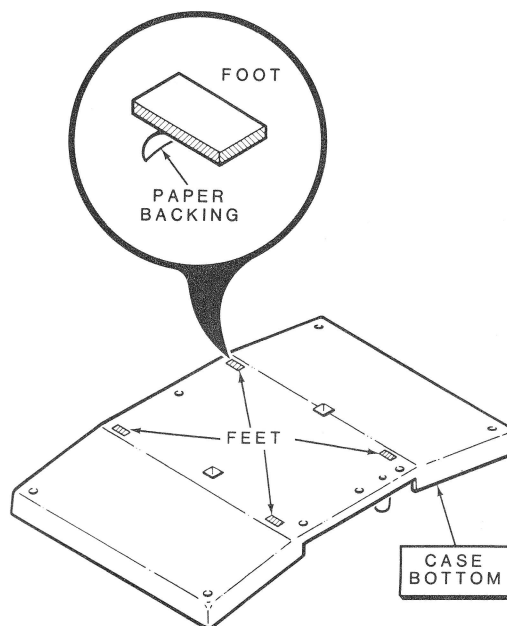
Detail 5-1A



Detail 5-1B

- () Mount the rear mounting bracket inside the case bottom opening with three 6-32 $\times$ $\frac{1}{4}$ " black phillips screws. Route the cable around the battery as shown.
- () Slide the push-on connector on the end of the red wire over the positive (+) battery terminal. Then slide the push-on connector on the end of the black wires over the negative (-) battery terminal.
- () Refer to Detail 5-1C, remove the paper backing from the feet, and press a foot onto each of the four case bottom locations as shown.

Set the case bottom aside.



Detail 5-1C

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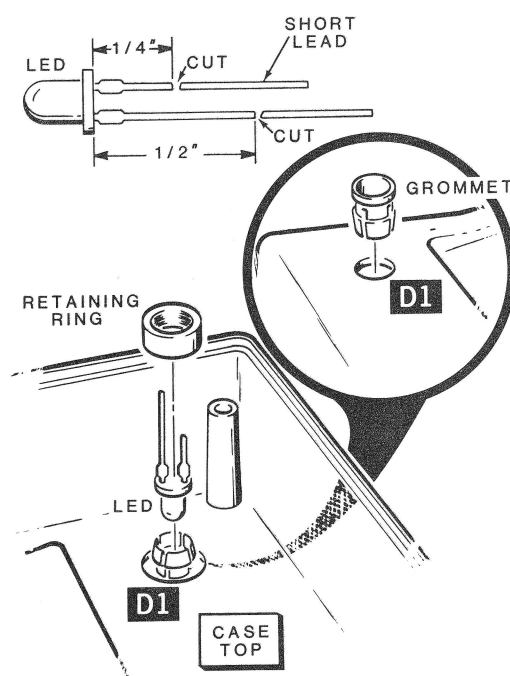
Refer to Pictorial 5-2 (Illustration Booklet, Page 10) for the following steps.

- () Position the case top as shown.
- () Install four T-bolts into case top holes A, B, C, and D.

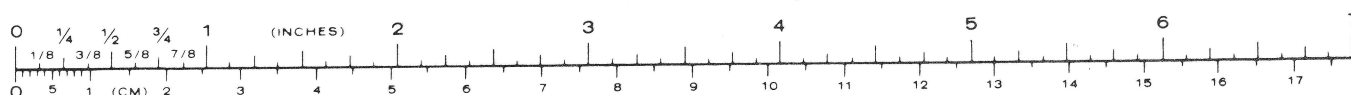
NOTE: When you install the following labels, make sure you install them properly the first time since they are almost impossible to remove without damage.

- () Install the keyboard label on the front of the case top as follows:
 1. Remove the keyboard label from the label sheet.
 2. Carefully align the top and side edges of the label with the edges inside the large recessed area of the case. Then slowly press the label onto the case, making sure the cutouts align properly.

- () Install two T-bolts from the inside of the case top at holes E and F. Slide the T-bolt shoulders into the recessed locations as shown.
- () Remove the motion label from the label sheet and carefully press the label inside the small recessed area of the case as shown.
- () Refer to Detail 5-2A and cut the shorter LED lead to $\frac{1}{4}$ " and the longer lead to $\frac{1}{2}$ ".
- () Press the grommet into case top hole D1. Then insert the LED case into the grommet as far as it will go (the LED shoulder should fit into the grommet so the top of the LED protrudes approximately $\frac{1}{8}$ " through the grommet) and install the retaining ring around the grommet to hold the LED in place. NOTE: Use a small-bladed screwdriver to press the LED into the grommet.



Detail 5-2A



Refer to Pictorial 5-3 (Illustration Booklet, Page 11) for the following steps.

- () Place a soft cloth on your work surface to prevent the case top from becoming scratched.
- () Position the case top on the cloth as shown.
- () Install the keypad into the case top so the bosses fit into the circuit board holes and the keys are positioned as shown.

NOTE: Be careful that you do not exert too much pressure on the four T-bolts when you mount the keyboard circuit board in the next step. Otherwise, you could damage the keyboard label.

- () Carefully install the keyboard circuit board over T-bolts A, B, C, and D with the cable positioned as shown. Then loosely mount the circuit board to the case top with four 4-40 nuts.

- () Carefully center the pushbuttons on the keypad in their case cutouts. Then tighten the four 4-40 nuts. Do not overtighten the hardware or you may crack the case.

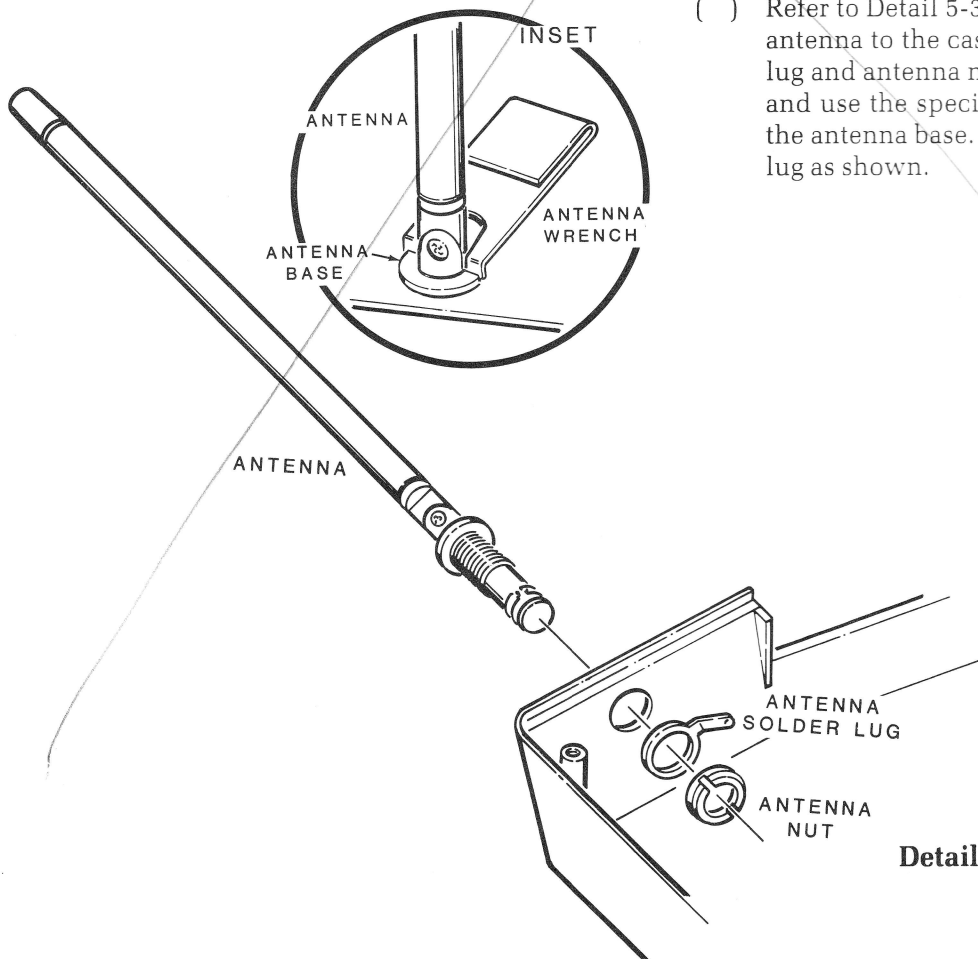
- () SW3: Open the rocker switch package and save the switch, lockwashers, and two nuts. Mount spacers and 4-40 nuts at T-bolts E and F. Then mount the rocker switch to the T-bolts with two ~~4~~⁵⁰¹ lockwashers and 4-40 nuts. Center the switch in the cutout before you tighten the hardware. Discard the unused hardware.

- () SW2: Mount a slide switch to the case top at SW2 with two 4-40 × ¼" phillips flat-head screws. Center the switch in the cutout and then tighten the screws.

- () SW1: Mount another slide switch to the case top at SW1 with two 4-40 × ¼" phillips flat-head screws. Center the switch in the cutout and then tighten the screws.

- () Press a rectangular knob over each slide switch button.

- () Refer to Detail 5-3A and mount the telescoping antenna to the case top with an antenna solder lug and antenna nut. Refer to the inset drawing and use the special antenna wrench to tighten the antenna base. Position the tab on the solder lug as shown.



Detail 5-3A



HEATH COMPANY • BENTON HARBOR, MICHIGAN 49022
TLX 72-9421

IMPORTANT NOTICE

Please make the following change in your Assembly Manual before you start to assemble your kit.

Page 40 — Tape the new Page 40, on the back of this Notice, over Page 40 in your Manual.

Thank you,

HEATH COMPANY

ET-18-3/595-3136
591-4545

Refer to Pictorial 5-3 (Illustration Booklet, Page 11) for the following steps.

- () Insert the four T-bolts into the cabinet top.
- () Place a soft cloth on your work surface to prevent the case top from becoming scratched.
- () Position the case top on the cloth as shown.
- () Install the keypad into the case top so the bosses fit into the circuit board holes and the keys are positioned as shown.

NOTE: Be careful that you do not exert too much pressure on the four T-bolts when you mount the keyboard circuit board in the next step. Otherwise, you could damage the keyboard label.

- () Set the PCB on top of the key pad, making sure all six rubber bosses on the key pad fit properly into the six holes in the PCB.
- () Start, but do not tighten down, the four nuts onto the four T-bolts.
- () Turn the cabinet right side up and center (left and right) the "RESET" and "D" keys by moving the PCB around.

NOTE: If the keys won't move easily, you probably tightened the four nuts under the PCB too far.

- () Once you have these keys centered, press the PCB lightly against the key pad and cabinet so they don't move while you tighten down the four nuts.
- () Tighten the four nuts either with your fingers or with the plastic nut starter. Over-tightening the nuts by using a different tool will cause the keys to stick down when operated.

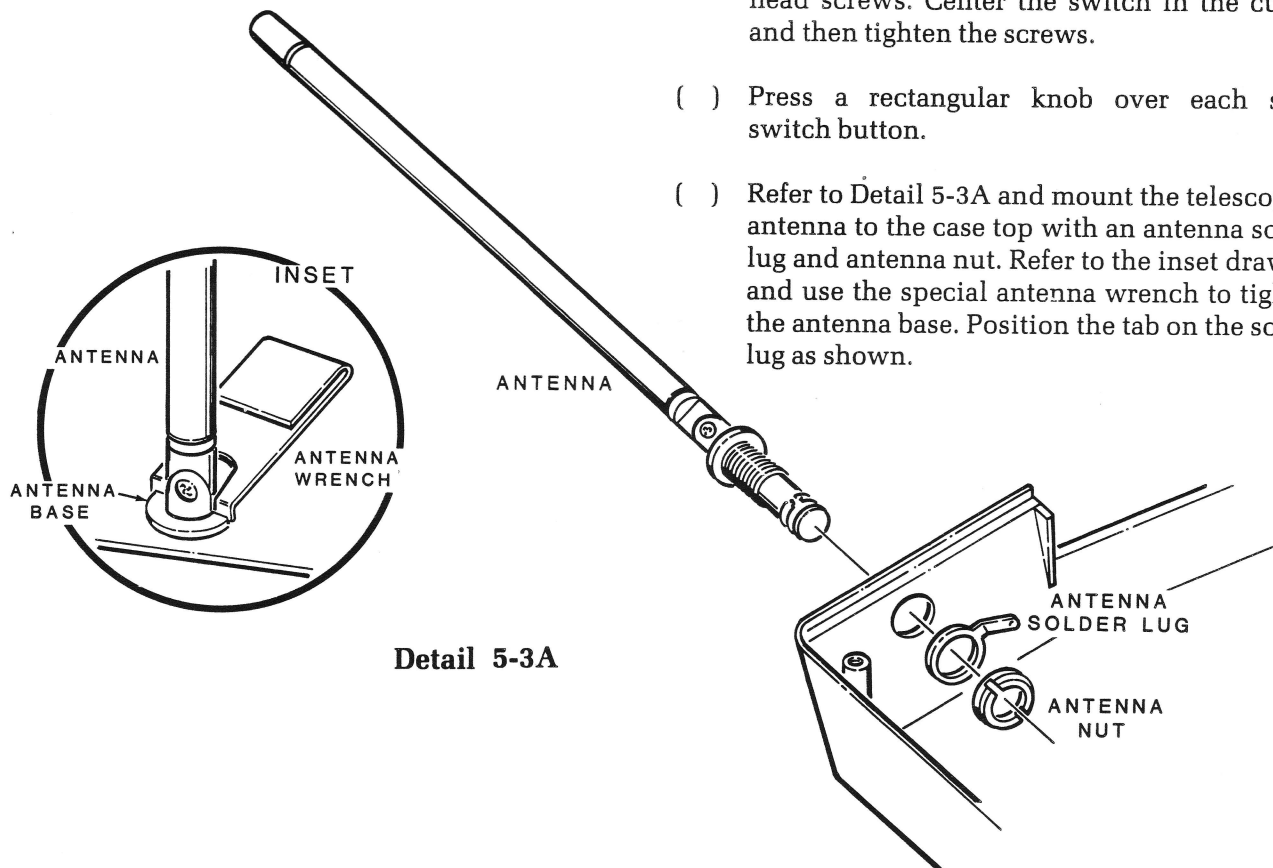
- () SW3: Open the rocker switch package and save the switch split lockwashers, and two nuts. Mount spacers and 4-40 nuts at T-bolts E and F. Then mount the rocker switch to the T-bolts with two split lockwashers and 4-40 nuts. Center the switch in the cutout before you tighten the hardware. Discard the unused hardware.

- () SW2: Mount a slide switch to the case top at SW2 with two 4-40 $\times$ $\frac{1}{4}$ " phillips flat-head screws. Center the switch in the cutout and then tighten the screws.

- () SW1: Mount another slide switch to the case top at SW1 with two 4-40 $\times$ $\frac{1}{4}$ " phillips flat-head screws. Center the switch in the cutout and then tighten the screws.

- () Press a rectangular knob over each slide switch button.

- () Refer to Detail 5-3A and mount the telescoping antenna to the case top with an antenna solder lug and antenna nut. Refer to the inset drawing and use the special antenna wrench to tighten the antenna base. Position the tab on the solder lug as shown.



Detail 5-3A

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Refer to Pictorial 5-4 (Illustration Booklet, Page 12) for the following steps.

- () Install the 2-hole connector on the end of the white-black and white-red cable wires over the LED leads with the white-red lead connector over the shorter LED lead.

- () Connect the white-yellow cable wire to the antenna tab (S-1).

Locate the 7-wire cable and connect the wires to rocker switch SW3 as follows. Be sure you position the lug wires away from the metal switch frame.

- () Blue wire to lug 1 (S-1).
- () Green wire to lug 2 (S-1).
- () Violet wire to lug 3 (S-1).

Connect the cable wires to slide switch SW2 as follows:

- () Gray wire to lug 3 (S-1).
- () Black wire to lug 2 (S-1).

Connect the cable wires to slide switch SW1 as follows:

- () Brown wire to lug 5 (S-1).
- () White wire to lug 4 (S-1).
- () Mount spacers over T-bolts A, B, C, and D.
- () Position the transmitter circuit board over the keyboard circuit board as shown and install the 15-hole socket over plug P501. The socket is polarized to fit only one way. Then mount the transmitter circuit board to T-bolts A, B, C, and D with four #4 lockwashers and 4-40 nuts.
- () Install the 8-hole socket on the end of the 7-wire cable over transmitter circuit board plug

P502, pins 8 through 15. Position the wires against the case. Make sure the violet wire is at pin 15.

IMPORTANT: Do not attempt to open or modify the transmit module. If you do, you will be in violation of FCC regulations concerning this kit.

- () Locate the transmit module you set aside earlier and insert it over plug P503. The module socket is offset so you can install it only one way. **NOTE:** You may find it easier to unplug the LED socket before you mount the module; then reinstall the socket with the white-red wire at the shorter lead.

- () Remove the backing from the blue and white label and press the label onto the inside of the case top at the indicated location. Refer to the model and series numbers on this label in any correspondence you may have with the Heath Company regarding this kit.

Refer to Pictorial 5-5 (Illustration Booklet, Page 12) for the following steps.

- () Make sure the ON/OFF switch is in the off position.
- () Place the case top near the case bottom and install the socket on the end of the 6-wire cable/w RS-232C connector over transmitter circuit board plug P502, pins 1 through 7. Make sure the orange wire is at pin 1.
- () Position the cable in the cabinet bottom inside the case top and mount the case halves together with six #6 × 1/2" black self-tapping screws. Be careful not to pinch any cable wires between the case halves.

This completes the "Step-By-Step Assembly" of your Remote Control Accessory. Proceed to "Installation" on Page 9 of your Operation Manual. You will be instructed on when to install the remaining parts left over from your kit in that Manual.

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.